

Building Our Health: Optimizing Human Health In Architectural Design

An Honors Thesis (ARCH 402)

by

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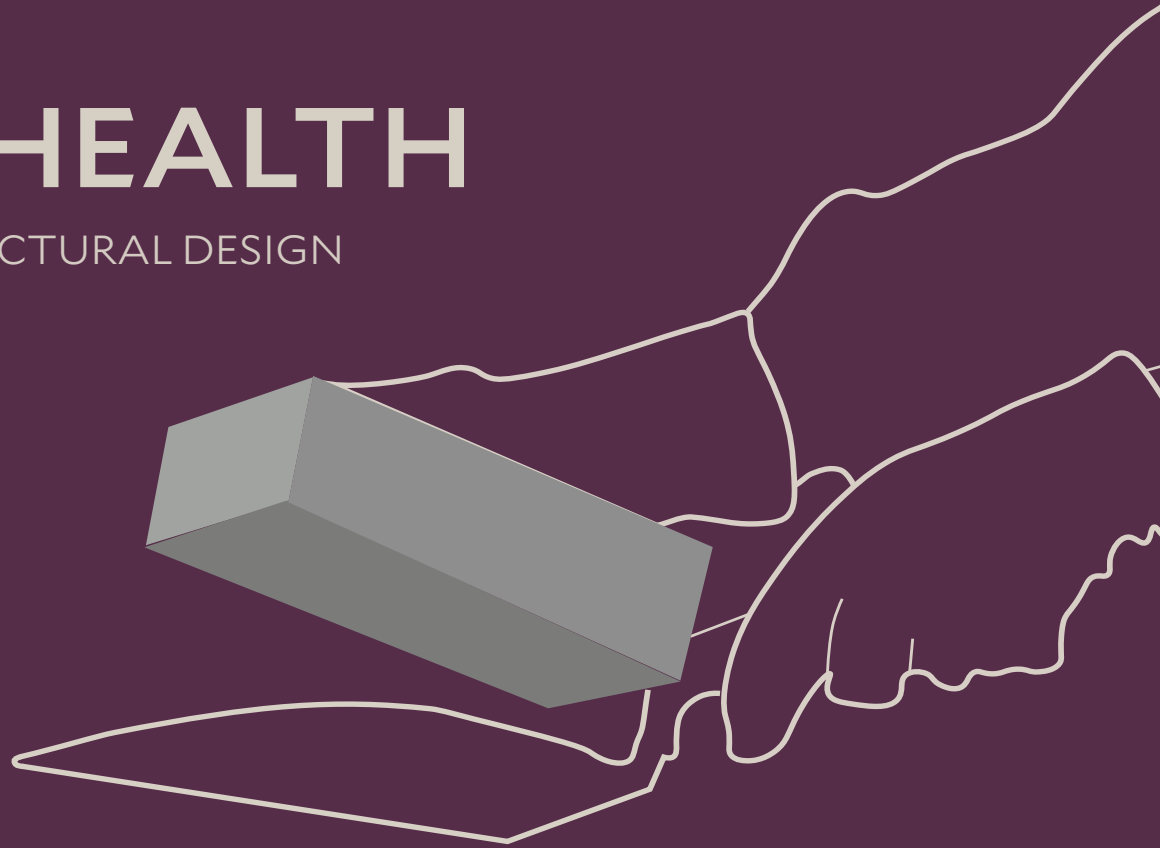
ABSTRACT

Given that we spend most of our time indoors- within homes, schools, and offices- it is critical to explore the physical and mental health consequences of how we design and operate buildings. The built environment can both positively and negatively affect our health, both physical and mental. Controllable conditions, such as air quality, daylighting, and potential for movement have an impact on the physical health of occupants. Building features such as the presence of nature and allowance of personal control and space influence the mental health of those who interact with an indoor environment. While designers aim to provide the most functional buildings, it is imperative to utilize strategies that provide the healthiest environments possible. This paper will examine the aspects of building design that make a difference in human health and outline strategies for improvement in both new construction projects and renovations.

BUILDING OUR HEALTH

OPTOMIZING HUMAN HEALTH IN ARCHITECTURAL DESIGN

KATIE FEDORONKO



ACKNOWLEDGMENTS

Thank you to my thesis advisor, James Kerestes for the advice, support, knowledge, and inspiration.

Also, to my friends and family for their input, encouragement, and help in editing.

“We shape our buildings, and afterwards our buildings shape us”
– Winston Churchill

BUILDING OUR HEALTH

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PROCESS ANALYSIS

Studying architecture at Ball State has opened my eyes to the massive impact that indoor spaces have on our lives. Buildings and landscapes are the stage of our lives and, like a theater, need to be designed and prepped to fit our needs. Not only does the a space affect a function or performance, but the emotional experience of everyone there. This thesis topic emerged from my interest in the psychology of architecture and my personal experiences.

Exploring the topic, I realized that not all buildings are created equal. I remember some rooms as cheerful and engaging, but others as dull and depressing. I asked myself, “What physical qualities led to my positive or negative experience of these spaces?” and started to categorize these aspects. I also knew that spaces having a negative quality can have longer-lasting effects on an individual from personal experience. Last summer I worked in an office (an architecture firm nonetheless) where I was stationed in a windowless room. Though it was only a few months, I found this environment to be energy-sapping and depressing. I was always thinking about how much our productivity and morale would improve if there was natural light, views, or even plants in that office space.

A strong belief was solidified within me that summer: design has a strong impact on our experience in life. If *where* we spend our time truly affects *how* we spend our time, then architects have the power to change lives. Doctors and policemen are esteemed for saving lives, but architects need to be recognized and held to the standard of designing places that nurture and improve our health and mental wellbeing.

The chosen focus of this paper is the impact of architectural design on the physical and mental health of those that inhabit designed spaces. There are a number of factors that are known to affect the quality of an environment and research shows an association with degradation of health in a variety of areas. My research started with exploration of specific topics known to influence health, such as light and air quality. These started to build evidence to support my theory and a knowledge of design implications.

This paper is divided into two sections, the first focusing on the factors that influence physical health and the second on mental health. For research to be meaningful to people who have never studied architecture, I created visual aids to reference in my writing. I designed two office buildings, one that displays the qualities found to have negative impacts on wellness and one displaying positive qualities. The resulting floor plans and various building photographs aid in the explanation of these positive and negative qualities. With comparison of floor plans, discernment of helpful and harmful features is made clear.

My decisions in creating spatial design guidelines were based on a more linear organization than the typical radial layout. In order to create a plan in which all workers receive daylight and are surrounded by an engaging and active environment, some elements, such as closed offices, needed to be eliminated. This could have gone into a discussion of ethics in design because I deemed health of all individuals more important than the privacy of a few. Working around safety codes was a challenge in my design process because codes are limiting to the materials and placement of elements, including stairs and elevators. Because it is not feasible to break codes about stair placement, a stairs was added in the improved floor plan. Whether this extra feature is in the budget would be up to the client, but my writing on active design justifies its worth.

Through this project, I found a passion for learning about the role of architecture in human health. I enjoyed researching psychological studies and scholarly articles on this emerging topic. During graduate studies and my professional career, I have the goal of continuing this research because it has brought meaning to my work and learning. While working on this thesis project, I have gained a better understanding of where to find sources of evidence and how to uphold my opinion throughout writing. It was a challenge to select just the topics I deemed most important to discuss because of the broadness of the topic and breadth of information available. The topics I chose to write about in detail are components of design that are most essential to human health. Also a challenge of this project was to make the topics applicable to all readers. This was overcome with the inclusion of detailed examples and images supporting them.

An important component of this writing is the provision of guidelines for improving the indoor environment. These are intended to raise awareness in both designers and inhabitants. Every person has the right to live and work in environments that allow them to be healthy and happy. When looking for a new job or home, individuals should be able to assess the quality of a designed space and realize the positive or negative impacts it may have on their wellbeing. I hope that, after reading this thesis, someone would have the knowledge to assess a space in this way. It is also my hope that strategies for occupant health will be implemented to elevate the field of design and its potential for building health.

[PHYSICAL HEALTH]

Physical health is not just the absence of disease but includes environmental factors and lifestyle behavior choices that influence health and avoid preventable conditions. Humans have particular needs to thrive in an environment and those lacking can be considered unhealthy environments. Architecture has emerged far beyond simply sheltering. The population continues to spend more time indoors and interact with an extended number of buildings on a daily basis. From hospitals to apartments, the qualities of indoor spaces have the ability to build or deter wellbeing. The built environment influences human health through its air quality, light quality, and promotion of activity and movement. Therefore, the decisions of designers of an indoor environment can significantly help or harm the physical health of the people that occupy it.

INDOOR AIR QUALITY

On average, Americans spend nearly 90 percent of their time indoors, according to the Environmental Protection Agency (epa.gov, 2019). Against general belief, the air breathed in most indoor environments is “on average two to five times more toxic than what is typically outside” (Howard, 2017). While the population continues to spend more time indoors than ever before, the quality of the internal environment is increasingly important to our wellbeing. It is important to understand the factors that contribute to poor indoor air quality, the health implications, and the ways that design can improve the physical health and productivity of building occupants.

During the energy crisis of the 1970s, architects aimed to seal buildings tighter to limit energy consumption. Windows are known to have poor thermal performance and, therefore, reducing heating and cooling loads meant less windows compromising the thermal quality of exterior walls. One of the consequences we now face in buildings of this design is stagnant air (Howard, 2017). Lack of windows for ventilation led occupants to experience a new phenomenon. The term “sick building syndrome” is used to describe a situation where at least 20% of occupants experience health effects such as headaches, upper-respiratory irritation, and irritation of the eyes (Grondzik, Kwok, 2015). Though no specific illness can be identified, the effects can be attributed to poor ventilation, presence of volatile organic compounds, high humidity, and other faults in indoor air quality. When the sources of air contaminants are identified, design can prevent or mitigate their presence in an occupied space.

Indoor air pollutants come in the forms of odors, irritants, toxic particles, and gases. They come from many different sources, but one of the highest contributors is the materials present and used in a space. Volatile organic compounds (VOCs) are pollutants that evaporate or “off-gas” at room temperature as gases from solids or liquids present in a space. Products including composite-wood materials, flooring, and furnishings that emit compounds into the air are a common irritant, especially in new buildings. VOCs enter the body through inhalation or through skin contact with products that release these toxic compounds (Allen, 2019). VOCs include a variety of chemicals, many of which are known to have adverse health effects. Short-term effects associated with the presence of VOCs include nausea, dizziness, headaches, and fatigue. Some of these compounds are also suspected to cause cancer in humans, particularly benzene and formaldehyde, carcinogens found in some air fresheners and treated wood. (Allen, 2019).

AIR QUALITY ISSUES BY SOURCE

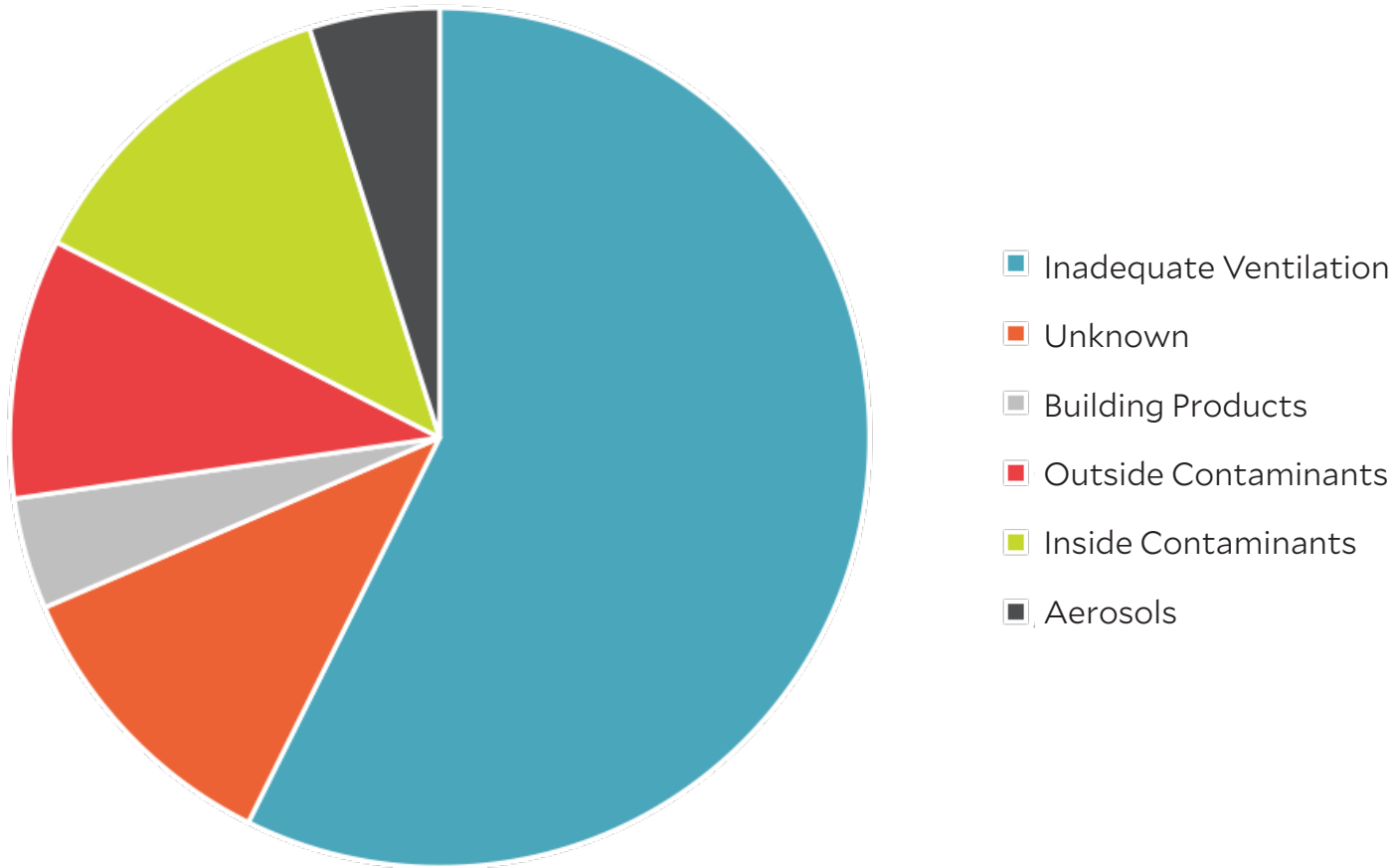


FIGURE 1: Sourced from the National Institute of Occupational Safety and Health

The primary duty of an architect is to protect the safety and wellbeing of all occupants that interact with an architectural design. While the architect may not be involved in management of a building after its construction, there are known issues that can be foreseen and mitigated before occupation of the building. Specification of interior materials and finishes is often the job of an architect or interior designer and many resources can be utilized to identify and select materials with the lowest VOC emissions. For example, many paint brands have a low-VOC or no-VOC option. Paints labeled “low-VOC” should contain fewer than 50 grams per liter of volatile compounds, according to Green Seal standards. Paints that are advertised as “natural” are often milk-based or chalk-based and have no VOC content. Although air contamination from paint subsides when it dries, some materials continue to emit VOCs for their entire lifetime. These include sealants and coatings such as fire retardants on furniture (epa.gov, 2019). These can be replaced with low-VOC options during product specification if a designer or owner is aware of the material's affects on indoor air quality.

Some materials off-gas dramatically when they are first manufactured but emissions taper off after a period of time. An example is the “new car smell” of newly installed vinyl. One way to mitigate the potentially harmful effects of new material installation is to let materials stay outside or in a garage for a period before bringing indoors. This gives the materials time to release toxic VOCs in a space where it will not compromise human health. This is particularly helpful for materials with high levels of VOCs that could off-gas quickly into an occupied space. Materials with this tendency include many building finish materials, such as carpets, vinyl, and highly processed or treated woods.

When installing materials associated with high VOC emissions in a new construction or renovation project, allowing a two-week ventilation “flush out” period prior to occupancy is recommended but rarely utilized (EPA.gov, 2019). Consideration of post-installation effects of materials is a critical and often overlooked step of the design process. It is especially necessary in high risk environments including where occupants are young children, elderly people, pregnant women, and people with asthma. In spaces where occupants have higher breathing rates, such as gyms and sports facilities, occupants have higher exposure risks as well.

Airborne toxins are most often identified by an odor (Grondzik, Kwok, 2015). If a space has a “new building smell”, best practice says that it should not be occupied until odors can be flushed out. A simple mitigation measure for the issue of toxic odors is to open the windows and increase the air change rate with natural ventilation. LEED programs give credit for building flush-outs prior to occupancy through increased airflow. This involves running the ventilation system with 100 percent outdoor air until a calculated volume of air has been supplied (epa.gov, 2019).

Additionally, activities within a building can produce their own pollutants. Close attention should be paid to cleaning products, electronic equipment, air fresheners, combustion processes, printing, and cooking activities (Hoisington, 2019). Levels of air contaminants vary with activity, ventilation rate, location, and many other factors. Levels of contaminants can change rapidly and building managers should always be attentive to symptoms of occupants. It is also important for designers to consider how a space will be used when specifying products and ventilation methods. For example, people whose occupation involves cooking are exposed to a high level of VOCs emitted by cleaning products, gas stoves, and grease. In this instance, it is important for to specify that stove hoods and vents that expel air outside the building, rather than recirculating it through the kitchen.

While increased airflow can be a means of reducing air pollutants sourced indoors, an overly high level of ventilation can cause its own problems. High ventilation rates that increase the supply of outdoor air into buildings can also increase the levels of outdoor airborne pollutants, such as carbon monoxide and ozone. In one study of an urban environment with high levels of air pollution, residents with higher ventilation rates were more likely to report negative health effects, especially respiratory issues such as chronic cough and asthma (Hoisington, 2019). In the design of HVAC systems, the best placement of an air-intake is upwind from pollutant sources, which include smoking areas, building exhaust, parking lots, and busy streets (Grondzik, Kwok, 2015).

Indoor air quality directly affects occupant health and is positively and negatively affected by the decisions in building design and operation. Possible pollutants should be considered both in initial design and throughout occupation to protect the wellbeing of people that spend their time in an indoor environment. Complete control of VOC pollution is not a simple task, but understanding sources, risks, and solutions can help safeguard occupant health.

ACTIVE DESIGN

Worldwide, we are facing a crisis of health that is caused not only by the choices that individuals make, but the environment that surrounds them. Research on community wellness indicate that health decisions are pre-disposed through the design of the built environment (Rice, 2019). Many diseases that are considered preventable are linked to sedentary behavior. The built environment may be able to curb the predisposition to these preventable conditions. When buildings feature an open layout, attractive circulation, and spaces dedicated to fitness equipment, movement and healthy lifestyle choices are promoted.

Increased sedentary time has become especially prevalent in the workplace. The average American spends up to 70% of their day in sitting or reclining positions (Alfonsin et al, 2018). A large body of research shows the numerous positive effects of regular physical activity on health and longevity. These include maintaining a healthy weight, improved energy and mood, and better sleep (Allen, 2018). Chronic diseases accounted for 63% of deaths worldwide in 2008, primarily diseases of the heart and vascular system. Inactivity is recognized as one of the leading risk factors globally for these chronic diseases (Booth et. al, 2012). As designers are creating places that people live, work, or learn in, it is important to consider how an environment will encourage or inhibit physical activity.

Active design is a concept that promotes movement, integrating physical activity into the everyday life of the occupant. Many people seek elevators first because the stairwells are dim and inconvenient. The layout and operation of the building actively designed encourages active transportation, meaning stairs are made more appealing than elevators for people that are able to use them. This is often done through the purposeful design of elegant, open stairways. Stairs with views to an atrium or the outside have been found to seem more appealing to occupants than dark, closed-off fire stairs (Urban Land Institute, 2015). Though enclosed stairways are required for fire safety, this does not need to be the only means of traveling between floors. Open stairs are a focal point waiting to be activated. They can be constructed with the same quality of materials and craft as any other feature of a building.

Floor plan A shows a typical office layout with central workstations and offices around the perimeter. While it shows spatial efficiency, this plan is lacking in human movement. During the workday, a person may walk the short distance from their cubicle to the restroom or from an office to the conference room. When needing to travel up or down floors, the elevator is easily found, while stairs are enclosed and tucked away in the corners. When it's time for a lunch break, an occupant may walk for fifteen seconds to the break area to sit and eat. There is no motive to walk around during a break because there is nowhere to walk to. Like many office buildings, this layout promotes stagnation.

FLOOR PLAN A

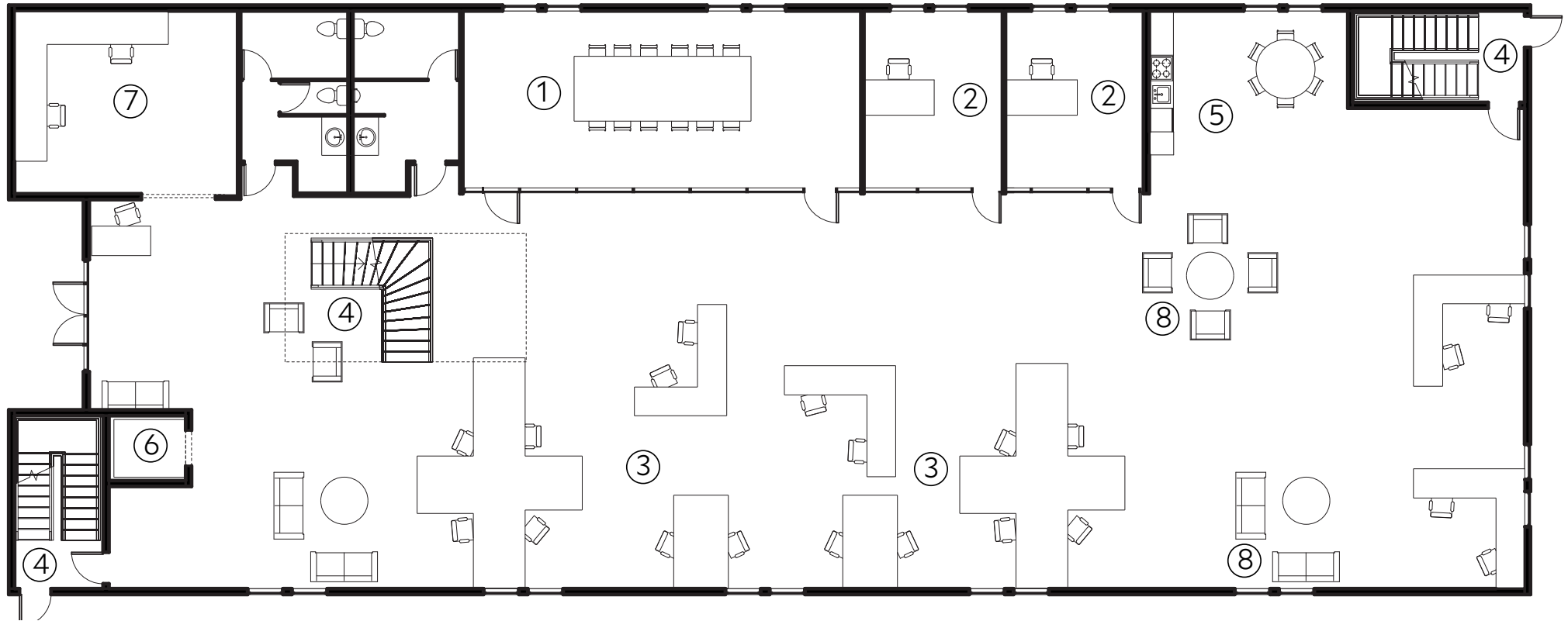


- 1 CONFERENCE ROOM
- 2 PRIVATE OFFICE
- 3 WORK STATIONS
- 4 STAIRCASE
- 5 BREAK AREA
- 6 ELEVATOR

When successfully applied, the principles of active design impact human health by helping building occupants integrate regular physical activity into their day. Current research shows that active design can have a significant impact on increasing the physical activity of building occupants, even if exercise is in short bursts. Studies focused on active design interventions show that regular stair climbing provides significant cardiovascular benefits (Allen, 2018). Additionally, buildings can aid in the formation of healthy lifestyles for its occupants. Active design guidelines encourage inclusion of exercise rooms in the workplace for the use of employees. Access to showers and bike storage at the workplace are ways to encourage employees to bike to work or take advantage of provided exercise equipment.

In renovation projects, designers have the opportunity to make circulation spaces more engaging for occupants. Improving lighting quality, updating fixtures, and adding place-making décor can transform a hallway from an avoided space to an appealing atmosphere. Individuals in engaging interior environments are more likely to organize walking meetings or lunchtime walking groups. Activating circulation spaces is a simple but effective way to integrate active design. Stairs can be made appealing through aesthetic treatments such as the introduction of vivid colors, artwork, and music. They should be finished with the same quality as corridors and occupied spaces to become more of an integral piece than an afterthought (Center for Active Design, 2010).

FLOOR PLAN B



- | | | | |
|---|-----------------|---|--------------------|
| 1 | CONFERENCE ROOM | 6 | ELEVATOR |
| 2 | PRIVATE OFFICE | 7 | SHARED OFFICE |
| 3 | WORK STATIONS | 8 | COLLABORATION AREA |
| 4 | STAIRCASE | | |
| 5 | BREAK AREA | | |

Floor Plan B shows an improved layout that utilizes the guidelines of active design. Though it occupies very similar square footage, this plan orients space in a way that encourages movement and interaction. Though enclosed stairwells are necessary, they are not the only stairs present. An additional staircase is added in the forefront of the building, directly visible when a person enters the lobby. This is meant to be a focal point and attractive feature. The elevator is not directly seen from the front entrance, but available nearby for the handicapped.

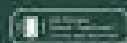
In many projects, introducing signage that promotes taking the stairs has been effective. These signs are placed next to stairways and elevators and state benefits or statistics of stair use. Figures 1-3 (right) show examples of signage that promotes active transportation. With positive messages and emphasis of the benefits, they put active transportation in a positive light. They serve as a reminder that stairs are a better option and viewing this message daily can have a large influence on the population's habits.

Active design is a vital step toward decreasing sedentary behavior in workplaces, schools, apartments, and other buildings. It gives movement a place in architecture where technology has pushed it to the periphery. With quality attention to stairs, corridors, and designated fitness areas, architecture can be reactivated for the promotion of physical health.

Burn Calories, Not Electricity



**Ditch
the lift**



StepJockey

Taking the stairs
cuts carbon emissions
and builds fitness

Track your
carbon footprint



4

CO₂ emissions (kg)



40

CO₂ emissions (kg)



CO₂ emissions (kg)



200

CO₂ emissions (kg)

800

CO₂ emissions (kg)

9.6k

CO₂ emissions (kg)



CO₂ emissions (kg)

Free workout just steps away



**TAKE
the
STAIRS**

LIVE
WELL

DAYLIGHTING

Light is the essence of human life. Research has found daylighting to affect human health, productivity, and behavior through the influence of energy levels, mood, and stress levels. Many buildings lack sufficient daylight and rely almost solely on artificial lighting. The presence of daylight in occupied spaces is a controllable condition that should be optimized by decisions in architectural design.

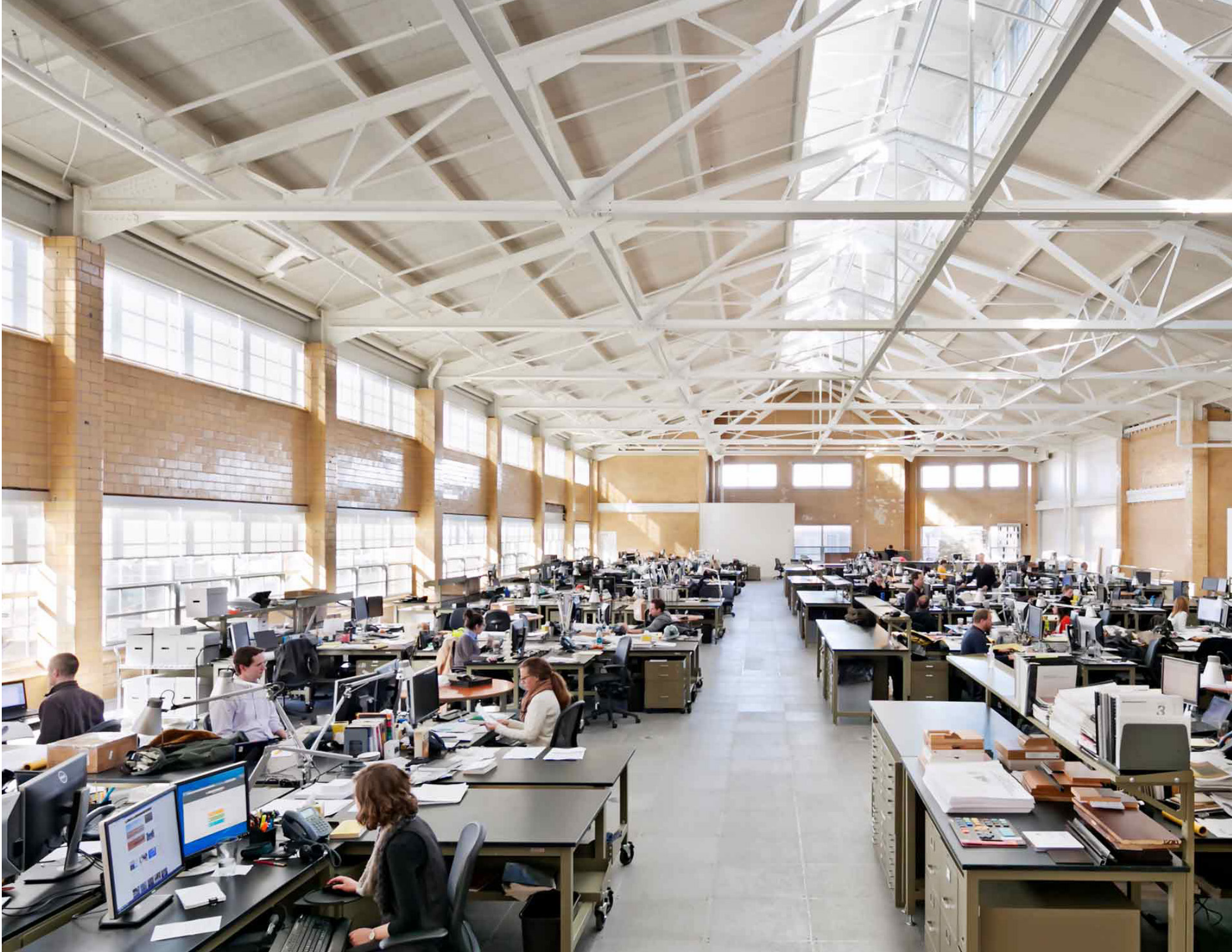
Humans need sunlight to maintain regular health and the absence can cause deficiencies in important vitamins. Natural light allows the process of photosynthesis to occur when in contact with our skin, producing vitamin D. This vital nutrient facilitates calcium absorption to strengthen our bones and its absence in the body leads to a range of illnesses.

The presence of natural light throughout the day is important for the maintenance of a regular circadian rhythm, the internal process that regulates natural sleep-wake cycles in humans. Research has shown that health benefits of quality building lighting can be attributed to improved sleep quality, while exposure to the alternative of cool white fluorescent lights disrupts the natural rhythm (Hoisington, 2019). In a study from the Journal of Clinical Sleep Medicine concerning natural light and vitality, workers in offices without windows reported poorer scores with respect to energy, physical activity and sleep quality in comparison to a group with windows. (Shishegar, Boubekri, 2016). While quality sleep is important to physical health, it is also vital in maintaining alertness and energy levels throughout the day.

FIGURE 2(TOP LEFT): center for active design

FIGURE 3 (BOTTOM LEFT) piction.co.uk

FIGURE 4 (RIGHT): ucla.edu



Natural light has been linked to improved alertness and mood. While artificial light is conducive to completing tasks and way-finding, the spectrum of daylight is most stimulating to humans (Rassia, Pardalos, 2012). We associate quality lighting most often with the spectrum of daylight because it causes the least strain on our eyes. Environments with natural light are also found to be the most productive due to less strain and improved mood. Studies in classrooms have shown that poor quality lighting leads to a decrease in information processing and learning ability, as well as higher stress levels in students (Shishegar, Boubekri, 2016). This is evidence that quality of light has a direct influence on the activities within a building.

Visual comfort is another positive affect of daylight utilization. Since the human eye adapts naturally to changes in luminance, or brightness, from sunlight, natural light will always be the most comfortable. This spectrum of light renders the environment in a way that is pleasing, particularly with representation of color, material, depth, and contrast. Comfort also stems from the absence of strain when lighting is adequate for the tasks at hand. Design of lighting, both natural and artificial, should reflect the needs of specific or general tasks. For example, reading, writing, and drawing require a higher level of illuminance, or amount of light striking a surface, than physical tasks or conversation.

Floor Plan A shows a layout that does not utilize natural light effectively. Because the private offices occupy the two longest exterior sides, light is not able to reach the center, occupied by employees at cubicle desks. The area in the center of the building will be left dark or dim. Many occupants will need to rely solely on artificial light and will also not receive the health and mood benefits of sunlight exposure. For the employees stationed in the center of the building, this layout may decrease productivity and increase eye strain.

FIGURE 5: Kieran Timberlake office
kierantimberlake.com

FLOOR PLAN A

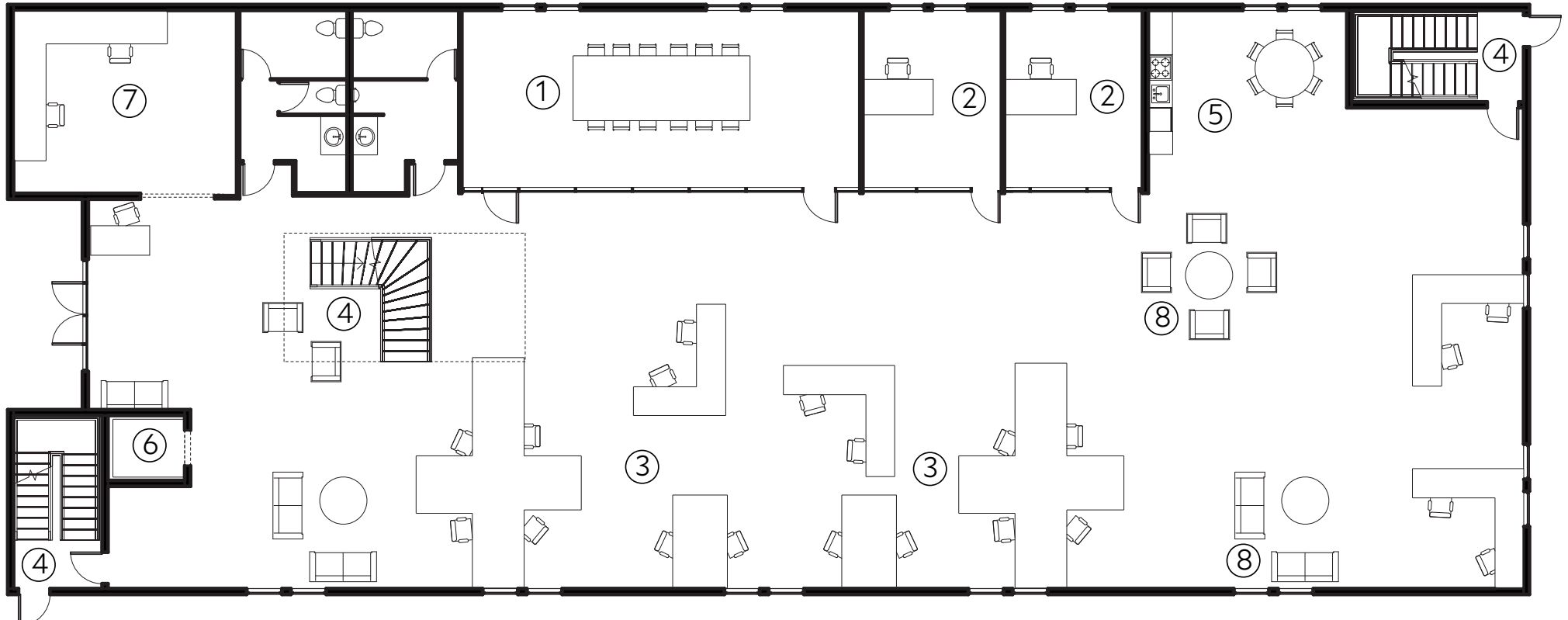


- 1 CONFERENCE ROOM
- 2 PRIVATE OFFICE
- 3 WORK STATIONS
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In new construction, consideration of window size and placement are critical in the performance of a daylighting system. Vertical windows are able to provide light at distances up to twice the window height. Specific attention should be paid to the height of a window, as the top will almost always bring more light into a building than the bottom. Skylights, light shelves, and lumiducts can bring natural light into deep spaces that are far from exterior walls (Rassia, Pardalos, 2012). *Figure 6* details numerous ways that sunlight can be brought into a space, other than the traditional fixed window. If an indoor environment seems to be unproductive, dim, or uncomfortable, there are means of improving the quality of light. In renovation projects or in post-occupancy, tactics such as the installation of light shelves or simply painting ceilings and walls white will help brighten a room naturally (Grondzik, Kwok, 2015). Furniture placement can also follow daylight patterns and functions can occupy the perimeter of a daylit space. For example, furniture in workstations and break areas can be moved within fourteen feet of windows. Because many windows are not more than three feet tall, the best illuminance will typically be within this distance.

Floor Plan B brings daylight into the entire building by decreasing the amount of enclosed offices around the perimeter, in comparison to *Floor Plan A*. Private offices that remain utilize glass curtain walls for transparency on the interior side, letting light pass through the space into those beyond. Workstations are centered along the outermost walls for enough daylighting to complete tasks without much need for artificial lights during the daytime. Though this building footprint is of very similar square footage, the floor plan is thinner to reduce the amount of dark space in the center that sunlight is unable to reach. Workstations are not cubicles, but movable desks that are placed in different configurations along the wall. These desks will receive much more sunlight than those of *Floor Plan A*.

FLOOR PLAN B



- 1 CONFERENCE ROOM
- 2 PRIVATE OFFICE
- 3 WORK STATIONS
- 4 STAIRCASE
- 5 BREAK AREA

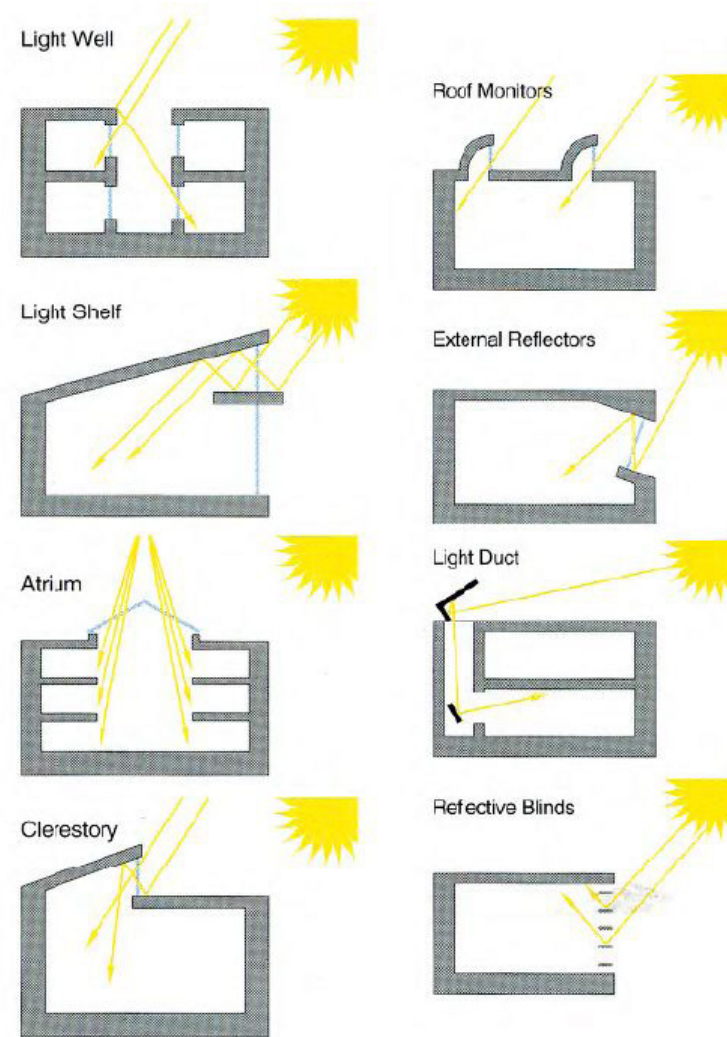


FIGURE 6: Daylighting Strategies
buildinggreen.com

In building layout, designers should utilize daylighting to improve the health, productivity, and mood of occupants. Areas of a building that receive quality sunlight can be used to their full extent by moving primary functions to this area. Sunlight is one of the key elements in healthy building design and should not be overlooked in planning.

CONCLUSION: PHYSICAL HEALTH

Architecture came about as a means of protecting humans from natural elements that posed health risks. The evolution of technology and materiality has brought architectural design to new levels. Not only are buildings able to protect from an outdoor environment but provide an indoor environment that significantly elevates wellbeing. Designing buildings for optimized physical health can greatly influence the lives of occupants. Since so much time is spent indoors, qualities of the built environment will continue to be determinants of human health. Conditions of the indoor environment such as air quality, active transportation, and sufficient daylighting are only the start. Research continues to provide more evidence to confirm the influence of environmental factors. Design professions should respond to findings to continue to elevate the quality of the indoor environment.

[MENTAL HEALTH]

According to the World Health Organization, the complex term of mental health can be described as “as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community”(World Health Organization, 2018). It is not simply the absence of a mental disorder and can be affected by the environments in which a person spends their time.

Humans often associate spaces with a feeling or emotion, calling an environment “relaxing” or “depressing”. These feelings can be positive or negative and influence the way a space is experienced. The way a place makes its users feel has everything to do with design choices, from the placement of windows to the layout of furniture. Factors such as perceived control, interaction with nature, and personal space promote mental wellbeing. There are actions that can be taken in the design and operation of built environments to improve mental health in any setting.

CONTROL AND STRESSORS

It is understood that humans are happier and have better mental health when they can control their surroundings. Feelings of helplessness and fear can occur when opportunities for control over the environment are removed (Evans, 2003). There are an infinite number of stimuli that can be considered environmental stressors and the impact varies with each individual. The inability to remove or control environmental stressors can be the cause of distress or anxiety. Although mental illness is genetically influenced, frequent unease and distress can contribute to the development of a disorder or agitate an existing one.

In building design, long interior corridors are commonly associated with a lack of personal control because this condition is perceived as a threat to safety. Unfavorable qualities include poor visual range, meaning that the next step or direction of travel is hidden from sight (e.g. around the corner). Areas with space for concealment, typically alcoves and dead-end hallways, also evoke stress because it gives the sense of endangering personal safety. Threat of personal attack, even if only speculated, is a cause of physical distress such as chronic anxiety. Another environmental stressor related to personal control is crowding. Stress is accentuated by nature in dense situations because crowds are seen as competition for resources and a threat to personal safety (Halpern, 1995). Because individuals will perceive situations differently, crowding is a subjective measure of density that exceeds a person's coping capacity (Park, 2016). Children in particular show adverse impacts on mental health in dense, crowded environments (Evans, 2003). Due to lack of control in crowds, stress levels are elevated. Feelings of helplessness, vulnerability, and fear are negative consequences that some individuals will face when interacting with the built environment.

Architecture today should be designed with the goals of safety and empowerment. The layout of buildings can be informed by the intended usage, occupancy, and traffic. Undersized rooms or corridors are sources of stress from crowding. Considering the expected use and how it might change in the future will help an architect find the most comfortable design solutions. Long hallways and large atriums can be broken up by smaller steps or landmarks within. Foresight in building usage and consideration from human scale will help curb the stress some occupants would experience.

One of the factors that positively influences mental health is access to quality social spaces. Design of social spaces at a range of sizes and locations within residential or office buildings may also facilitate a sense of control. Research from the Journal of Urban Health suggests that, “To have options from small, intimate spaces for solitude, through group spaces, to larger, more public interaction opportunities is associated with greater perceived control and comfort” (Evans, 2003). Because every person has a different level of comfort with social interactions, it is highly beneficial to have options. With a variety of social spaces, both the introvert and the extrovert will feel a sense of control over their situation.

Social interaction is promoted by proximity and the presence of focal points. Successful focal points are visually distinctive and perceived as “neutral” and accessible by all. Furniture choices can also aid in the perceived control of occupants. Desks, tables, and chairs that are movable or modifiable can induce feelings of ownership (Park, 2016). This small but effective amount of control may keep occupants happier and more engaged.

Public participation in the building planning process is an effective way to help occupants feel in control of their environment to some extent (Halpern, 1995). Both the product and the process of building design can influence mental health because exclusion can provoke feelings of powerlessness. People who interact with a building regularly are highly affected by the decisions made in the design and planning process. Their opinions should be considered to produce the outcome that is most effective in elevating perceived control and mental health.

NATURE

In potentially challenging environments, such as a schools, hospitals, and offices, design that reduces stress is critical for mental wellbeing. One of the most effective strategies in modern practice is to accentuate the presence of nature. Plants and other elements of nature are brought into occupied spaces to reduce stress and diminish cognitive fatigue. Why humans react more positively to natural landscapes over built landscapes relates to our nature and evolution. Research has revealed in many ways that humans are linked to the natural environment at a deeper level than the built environment. The “biophilia hypothesis” proposes that humans have a deep-seated need to connect with nature and that exposure to the natural world is therefore important to human wellbeing (Seymour, 2016). The intent of biophilic design is to integrate natural features and systems into the built environment, providing occupants with the exposure to nature they need. (Gillis, 2015). Modern building practice has tended to keep the indoor and outdoor environments separate. Some buildings were purposely designed with limited windows to reduce the “distractions” of a view. However, this practice is being discredited and discontinued as new research provides evidence that views support productivity and satisfaction. Trends aiming for healthier and happier environments seek to bridge the gap between the built environment and landscape.

The human sensory system evolved in the natural world, modern theory suspects that human brains become relaxed in nature because it is full of stimuli we were designed to look at, hear and to smell (Worral, 2017). Studies have shown that perceived and actual productivity is increased for occupants in a green office space when compared with a minimalist office space.

*FIGURE 7: Common Ground High School
Photo by David Sundberg*



Research has shown that contact with nature may reduce stress, improve memory, and increase feelings of kindness, happiness and creativity. Neuroscientists have found that the frontal lobe, the part of our brain that's hyper-engaged in the moment, is less engaged when a person is among natural elements. When a person is depressed or experiencing high levels of stress, this part of the brain seems to malfunction, leading them to experience a continuous loop of negative thoughts. When among some level of nature, alpha waves that indicate a calm but alert state, grow stronger (Worral, 2017). This explains why environments that exhibit the natural world are deemed more productive and relaxing spaces to work or learn. Recent studies have found humans to hold preference for scenes dominated by natural elements because of this calming effect and innate attraction. The positive effects of interaction with spaces where nature is present include improved cognitive functioning and improved health. These benefits also increase with intensity and duration (Seymour, 2016). Views of nature have even been shown to speed healing in hospitals because of decreased stress levels and improved mood. This occurs because blood pressure is lowered and levels of the stress hormone cortisol is reduced, which calms the body's fight-or-flight response (Harvard Health, 2018). Nature could be a powerful tool in regaining the health of our population and reducing the stress of everyday life.

Use of biophilic design could have major impacts on the way our population works, studies, lives, and heals. Moves to integrate nature in the built environment don't need to be dramatic. Designers can work to provide views of nature through strategic placement of windows, bring plants indoors, or decorate with pictures and paintings of nature. Places where these strategies are beneficial include but are not limited to public buildings, hospitals, workplaces, and homes. Changes to the indoor environment don't need to be exaggerated, the simple act of bringing plants (live or fake) into spaces regularly used is a step in the right direction. When new construction is being designed, consider advocating for a green wall or green roof. Designers have utilized a variety of green aspects in biophilic design from small to large scale and new methods are constantly on the rise.



*FIGURE 8: Office Space in Warsaw, Poland
officesnapshots.com*



*FIGURE 9: Office Space in Washington D.C.
inhabitat.com*

PERSONAL SPACE AND INTERACTION

The maintenance of personal space is important to humans regardless of the setting. It is human instinct to seek some degree of privacy and ownership, especially within larger spaces. Territoriality can be defined as the ability to monitor and to regulate the use of space (Veitch, 2011). When a person has the ability to control their environment, stressors are reduced. In homes and offices, defining one's personal "place" is very common, such as a desk, room, or seat they routinely occupy. They might put photos on the desk or bring in their favorite succulent, defining themselves in that space. This sense of ownership is beneficial for mental stability and comfort because it allows exercise of territoriality that is instinctive by nature.

Though humans need some amount of personal space, social interaction is also important. Architectural features can cause isolation or facilitate needed interactions. Furniture types and arrangements can encourage socialization through their mobility. If desks, chairs, and sofas can be rearranged for varying group size, one can adjust positioning for the proper physical distance, ease of eye-contact, and comfort (Evans, McCoy, 1998). This aids in group and individual identity and empowerment through facilitation of perceived ownership. Furniture with some ability to be repositioned is especially beneficial in large building settings, such as schools and offices. The grand scale of architecture can be overpowering, but small measures such as furniture design can help bring human scale to the extensive.

Architectural features contribute to the development of social cohesion in work groups, in part by defining groups by proximity. Proximity facilitates interaction, social support, and communication. However, privacy must also be balanced in the equation. Privacy, or the ability to regulate social interaction, greatly influences sense of personal control in interior environments (Evans, McCoy, 1998). Each person has different comfort levels with social interaction and solitude.

*FIGURE 10 (TOP): Google's collaborative office space
researchgate.net*

*FIGURE 11 (BOTTOM): Bennett Elementary school
bdcnetwork.com*



A person isolated in a small office may experience symptoms of depression because they lack the social interaction and support needed. Likewise, a person whose desk is along a highly trafficked corridor may experience anxiety because they lack sufficient privacy. Therefore, privacy needs vary with the individual's preference and situation, but most benefit from the ability to expand or limit interaction. The most effective way to incorporate privacy options is to include usable spaces in a variety of sizes, from a single person to a large group. Phone "booths" are small rooms that individuals can use to take a call. These are helpful in eliminating stressors because it secures privacy for the duration of a conversation. Lounge areas of various sizes are also important to accommodate large group interaction or collaboration. If there are no quality spaces to gather, a group may be less likely to socialize or work effectively together. This is true in any collaborative environment, including offices, schools, and design studios.

Floor Plan B is an example of a layout that utilizes movable furniture for the benefit of employee interaction. Instead of securing desks in a rigid grid, the office workstations are laid out in irregular patterns. Small set-ups for group interaction float in open space around the flexible plan. Overall, this plan is more modifiable in the hands of the users than *Floor plan A* and would likely facilitate stronger collaboration and social support.

By nature, humans need some level of control over their environment. Strategies used in modern practice let users have some level of control over privacy, social interaction, and furniture layout. Successful strategies to improve both perceived territoriality and group interaction include selection of furniture with mobility and incorporation of settings for collaboration that suit different group sizes. Use of these strategies may help facilitate a more collaborative environment. Stressors related to too much or not enough social interaction can be decreased, improving the mental health of people that use the indoor environment.

CONCLUSION: MENTAL HEALTH

Designing for function is a given in architectural design, but designing for mental health requires another level of thought and attention. A person with strong mental health realizes his or her own potential, and can work productively and fruitfully, despite the stressors of everyday life. Influence of an environment starts with the way it makes a person feel, but runs deeper. Intangible factors such as perceived control, interaction with nature, and control of privacy levels are some of the many determinants of mental wellbeing. Strategies relating to mental health optimization center around personal options because each person has different preferences, conditions, and needs. Understanding the sources of anxiety and stressor that harm mental health can help elevate the design and implement strategies for continued improvement.

BUILDING OUR HEALTH

Society is increasingly aware of the determinants of health, encouraging healthy practices that include time among nature, seeking sunlight, staying physically active, and building interpersonal connections. A critical question to ask is, “Are buildings being designed to respond to this new consciousness?”

What makes a “healthy building” is not a series of rules, but a consideration of usage and human needs. A designer should determine how a building will be used and what can be done to improve the experience of occupants. The built environment can be both a negative and positive contributor to physical and mental health. Controllable conditions, such as air quality, daylighting, and promotion of movement have an impact on the physical health of occupants. Architectural features including the presence of nature, minimization of stressors, and allowance of personal space influence the mental health of those who use a designed environment. Research is available to confirm impacts of architectural features on human health and wellbeing. The next steps are to inform the population about both negative and positive factors to raise awareness and implement changes where needed. Awareness can encourage advocacy of more health-centered design. Some mitigation and improvement strategies have already shown a significant difference in environmental quality and many more are yet to be designed. With the knowledge, resources, and creativity of the design field, the potential for optimizing human health in architectural design is immense.

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